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LTL-XL RETROREFLEKTROMETER

Manual

On site quality control of road markings & road surfaces in accordance with CEN / ASTM specifications

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

R&TTE Declaration of Conformity (DoC)

Unique identification of this DoC: 80_LTL-XL EU_DoC 001

We,

DELTA Dansk Elektronik, Lys & Akustik
Venlighedsvej 4, Hørsholm
DK-2970 Hørsholm

declare under our sole responsibility that the product:

Product name: LTL-XL Retrometer
Trade name: DELTA LTL-XL
Type or model: All types pursuant to the referenced trade name

to which this declaration relates is in conformity with the essential requirements and other relevant requirements of the R&TTE Directive (1999/5/EC).
The product is in conformity with the following standards:

HEALTH & SAFETY (Art. 3(1)(a)):
EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011
EMC (Art. 3(1)(b)):
EN 301489-1 V1.8.1:2008
EN 301489-3 V1.4.1:2002
SPECTRUM (Art. 3(2)):
EN 300440-2 V1.4.1:2010

Supplementary information:

The equipment incorporates a GPS module.
The equipment is Class 1 radio equipment which can be placed on the market and be put into service without restrictions.

Technical file held by the undersigned.

Place and date of issue (of this DoC): July 1st 2012

Signed by or for the manufacturer:

.....
(Signature of authorized person)

Name (in print):
Pernille Veje
Vice President QA/RA & E

CE

US Attestation of Conformity (AoC)

Unique identification of this AoC: 80_LTL-XL US_AoC 001

We,

DELTA Dansk Elektronik, Lys & Akustik
Venlighedsvej 4, Hørsholm
DK-2970 Hørsholm

declare under our sole responsibility that the product:

Product name: LTL-XL Retrometer
Trade name: DELTA LTL-XL
Type or model: All types pursuant to the referenced trade name

to which this attestation relates is in conformity with the essential requirements and other relevant requirements of 47 CFR FCC Part 15.

The product is exempted from other specific FCC rule parts than the general rule parts 15.5 and 15.29 pursuant to specific rule part 15.103(c), as it is intended solely for use as industrial test equipment. However, the product is verified according to the specific rule parts:

47 CFR Part 15B, subpart 15.107 (Class A)
47 CFR Part 15B, subpart 15.109 (Class A)

The equipment is safety tested with CB Scheme certification under the internationally harmonized safety standard:

IEC 60950-1:2005 (2nd Edition); Am 1:2009

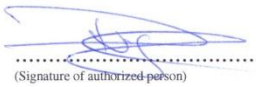
Supplementary information:

The equipment incorporates a GPS module.

Technical file held by the undersigned.

Place and date of issue (of this AoC): July 1st 2012

Signed by or for the manufacturer:



.....
(Signature of authorized person)

Name (in print):
Pernille Veje
Vice President QA/RA & E

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Visit our web-site "www.roadsensors.com"

SECTION 1

OPERATING INFORMATION

LTL-XL introduction

The LTL-XL retroreflectometer is a portable field instrument intended for measuring the retroreflection and reflection properties of road markings. LTL-XL measures the R_L value (coefficient of retroreflected luminance at night) and the Qd value (day light visibility). R_L is a measure of the lightness of the road marking as seen by drivers of motorized vehicles in car headlight illumination. The road is illuminated at an angle of 1.24°. The illumination for Qd is diffuse. The reflected light for both R_L and Qd is measured at an angle of 2.29°, which corresponds, to an observation distance of 30 meters. This is relevant for a motorist's viewing situation under normal conditions. Further information on measuring principles and standards can be found on "www.roadsensors.com/technical information".

R_L and Qd are important factors in the **ON-SITE** quality control of road markings.

Figure 1. The instrument

The operation of the retroreflectometer is very simple and requires minimal instruction.

The LTL-XL measures the retroreflectivity and calculates R_L and Qd according to the international CEN and ASTM standards. Results are presented in plain text on a large graphic display. Error messages or warnings are shown in the display in case of any problems during use. The memory of the instrument provides registration of measurements with corresponding date, time and other relevant data. The following data is also registered (if enabled):

- Name of measuring series (road name)
- Profile icon for road marking type
- User name
- GPS data (if installed)
- Temperature & humidity
- Instrument status

The measurement results can be printed by the build-in printer (optional). Communication with a PC using the RSC (Road Sensor Control) software program (**see pg. 36**) allows for data exchange with other PC programs.

A rechargeable NiMH (Nickel-Metal Hydride) battery powers the LTL-XL, giving hours of measurement capacity. A mains powered battery charger is supplied as standard. Charging time is approx. 1½ hour. The instrument can also be charged from a 12-18V source such as a car battery using an adapter.

LTL-XL retroreflectometer features

- Portable instrument
- Small dimensions / low weight
- Ergonomic operation height
- Fast measurement (completed in less than 1 sec. for R_L or Qd and 3 sec. for R_L +Qd)
- Measuring on dry and wet surfaces
- Will measure flat, textured & profiled markings up to 5 mm
- Fully documented measurements with automatic data storage, user and series identification for labeling and grouping measurements
- Audible signals during use (if enabled)
- RSC (Road Sensor Control) PC software for data exchange. Log data can be exported to applications such as Microsoft Excel
- Easy calibration procedure
- Traceable and accredited calibrated reflection standard
- User replaceable battery
- Fast charging (approx. 1½ hour)
- Rechargeable from power adapter or a car battery using an adapter
- Average (2-25 readings)
- Multiple languages

Options

- Build-in GPS for precise logging of measuring location
- Wheel unit and extendable handle
- Build-in thermal printer

Getting started

Buttons:

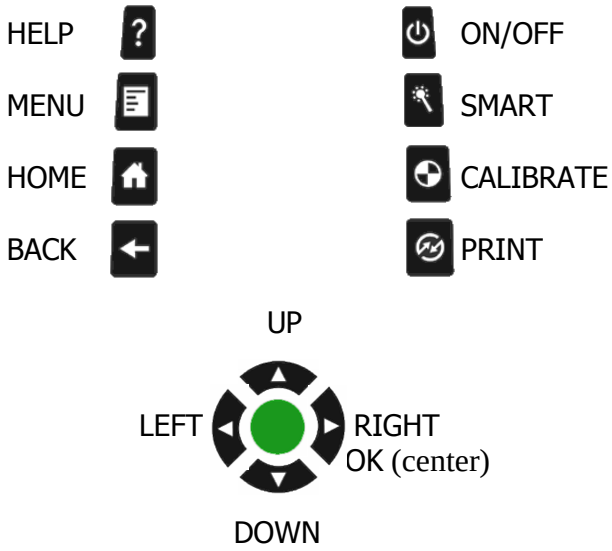


Figure 2. Buttons

Height adjustment (optional)
Before using the LTL-XL, notice that the operating panel can be adjusted in height for ergonomic considerations. The height is adjusted by pressing the red knob on the front of the instrument and at the same time lifting the handle on the operating panel. Release the knob and continue lifting until the handle locks.

Switch on

Switch on the LTL-XL by pressing and holding the ON/OFF button until the display turns on. The instrument will be ready for measuring within 30-40 sec from cold. From warn start the instrument will be ready within 1 sec.

Measuring

Calibrate the instrument if necessary. DELTA recommends calibrating the instrument every time the instrument is switched on and / or starts a new series of measurements. See **Calibration, pg. 39**

Place the instrument on the road marking.

Press the green OK-button to take a measurement. A measurement will be finished in approx. 1 sec. / 3 sec.

When the measurement is complete, the R_L and/or Qd value will be displayed. Data is automatically transferred to the data log. If there is a problem with the measurement a warning icon or an error icon will pop up (see **Errors and warnings, pg. 36**) and an audible alarm will sound (if enabled, see **Sound settings, pg 21**).

Measurements taken with a battery voltage that is too low are rejected or marked in the log and an error icon appears.

To print the last measurement data, press the PRINT button .

User select (user initials)

If a user icon is displayed in the upper icon row on the measuring display, press the UP button ▲and if necessary ◄ or ► to mark the user icon. Press the OK button to enter the user select menu. For further information see **Selecting a user id, pg19**

Series ID select (name)

If a user icon is displayed in the upper icon row on the measuring display press the UP button ▲to mark the road icon. Press the OK button to enter the series ID select menu. Select a name from the list using UP or DOWN and accept with OK or ENTER / EDIT a new name.

Calibration

The instrument is supplied with a reference calibration unit. The reference calibration unit is factory calibrated and traceable to PTB and NIST.

Calibration procedure

Before a calibration is carried out make sure that the calibration unit is clean.

To carry out a calibration go through the following steps:

- Before mounting the calibration unit check the RL and Qd values stamped on the calibration unit.
- Mount the calibration unit underneath the instrument. Make sure that the pins on the interface plate fit into the holes on the calibration unit. Be very careful when you place the instrument on the calibration plate not to damage the calibration unit and / or the light diodes
- Press the CALIBRATION button once. Select RL or Qd calibration to calibrate one at a time.
- Check the value displayed, if necessary adjust the calibration value shown in the display so it matches the value stamped on the calibration unit. See the Calibration section for details.
- Press the OK button to finish the calibration or repeat if erroneous.
- Repeat the calibration process for the other measure (R_L, Qd)

The calibration procedure is now complete. Remove the calibration unit and store it properly. Press OK to return to the measurement display. For further details see **pg. 41**.

Errors and warnings

An error or warning icon will appear in the upper row of the display if the LTL-XL detects a problem. Press the UP button ▲ to get a description of the most serious error or warning. Now press the OK button to display a total list of all errors or warnings related to the measurement and the instrument in general.

Sound setting

Press the MENU button and select **SETTINGS / SOUND**. Select **KEY CLICK** or **SOUNDS** to set the individual sound levels for key click and system sounds. Use the UP ▲ or DOWN ▼ button to set the level. Accept the setting by pressing the OK button.

Miscellaneous

The HOME screen can be activated at any time by pressing the HOME button .

Reset log: Press the MENU button and select **LOG / CLEAR DATA .** Now select from the menu: **CLEAR LAST DATA, CLEAR ALL DATA** or **CLEAR SERIES DATA**.

Date and time: Press the MENU button and select **SETTINGS / DATE & TIME / SET TIME/DATE**. Use the UP ▲ and DOWN ▼ buttons to set the different time related settings.

Power save: Press the MENU button and select **SETTINGS / POWER / AUTO SLEEP, AUTO OFF**. Use ▲and ▼ to edit the values.

Data exchange / communication

The RSC software program, developed by DELTA for use on a PC, allows data to be exchanged between the LTL-XL and a PC. See **RSC-program, pg. 36.**

Important guide lines for the correct use of the LTL-XL

Positioning of the instrument on the road marking
Select an area of the pavement marking that is level when taking readings. The measurement field is marked with a yellow sticker on one side of the base cover. The measurement field is approximately 50 mm wide and 185 mm long. Ensure that the pavement marking to be measured before taking measurements is free of debris. Make sure that the instrument is stable positioned.
Reason: The LTL-XL has three support pads, each with a small footprint, two smaller in the front and one larger at the back. An uneven marking or a small piece of gravel trapped below one of the pads will move the measurement field and affect the reading.

Taking the measurement
Press the green OK button to take a single or double reading as selected. Do not put pressure on the handle when taking a measurement.
Reason: Pressure on the handle can affect the measurement geometry and thus influence the reading.

Number of measurements.
For accurate readings, do not take just one reading of a road marking. Three readings will give a more accurate result than one reading. Five readings will give an even more accurate result than three readings, etc. Take the readings in adjacent areas of the marking. Let the instrument calculate the average of the readings (fixed or moving average options).
Reason: A road marking's retroreflectivity varies from area to area. It is not unusual to see variations of 5% - 20% when the instrument is moved even less than 10 mm / ½" in either direction.

Protection of the display/display shield.
For the protection of the display and longevity of the instruments keep the display shield closed when the instrument is not used. For further information please see section 2.

Remember:

- LTL-XL is an optical precision instrument, handle with care.
- Keep the protection window and calibration unit clean and undamaged.
- Store in a clean, dust free and dry environment.

Read:

Measurement practise for road markings. This leaflet can be located on:
http://www.madebydelta.com/imported/images/DELTA_Web/documents/LO/roadsensors/ltl-x-xl/Measurement-practise-for-road-markings.pdf

SECTION 2

GENERAL INFORMATION

The measurement

The LTL-XL retroreflectometer measures the R_L (coefficient of retroreflected luminance) parameter and Qd (the day light visibility). The R_L parameter represents the brightness of road markings seen by drivers of motor vehicles by headlight illumination. Qd measures the visibility of the road markings under day light conditions.

In the LTL-XL the illumination angle is 1.24 degrees for R_L, the illumination for Qd is diffuse. Both observation angles are 2.29 degrees. According to both ASTM and CEN standards these angle simulates a driver's viewing distance of 30 meters. The instrument's illumination field is approximately 185 mm x 50 mm / 1.97 x 7.28 inch.

The LTL-XL is controlled by multiple microprocessors. It is operated with an extractable keyboard located at the top of the retroreflectometer. It executes the measurement automatically by a push of the green button and presents the result on a display. The result is automatically transferred to the internal memory. The measurement, along with its corresponding time, date, and other data can be printed using a printer (optional).

Optical principle

The optical system in the LTL-XL is covered by a patent. A LED lamp in the top of the tower generates the light for the R_L measurements. After a field stop the light is collimated by a lens and deflected through a mirror toward the road. The diffuse Qd illumination is based on an array of LED's.

The reflected light from the road uses the same mirror and lens. Between the lens and the photo detector field aperture, stops define the observation area. The illumination field is inside in the observation field. This is important to assure correct measurement on profiled markings.

V_λ spectral correction is achieved by use of advanced optical filters.

Notes on error sources

Stray light can occasionally enter the instrument but will be insignificant under normal measurement conditions. Before each measurement, the LTL-XL automatically evaluates the leakage and compensates for it before the readout. In case of a significant leakage level, a warning or error message is given and special precautions may be necessary.

Instrument leak, drift and offset errors are compensated by means of data obtained during the calibration procedure. It is very important to keep the dust-protection window and the ceramic on the calibration unit clean.

The LTL-XL illumination angle is 1.24° relative to the road surface. Because of this small angle accurate placement on the road is important. Avoid pebbles and abnormal irregularities. The LTL-XL must be parallel and in contact with the marking surface.

The LTL-XL retroreflectometer is a rugged instrument, but it is an optical instrument and must be handled as such.

The LTL-XL is factory calibrated. Nevertheless start measurements with a calibration. Study the display for any warning or error icons. See **also Section 4 - Maintenance**

Note

Keep the dust-protection window and ceramics on the calibration unit clean.

Keep the battery fully charged. A well charged battery is more resistant to aging and damage.

High temperature conditions.

Display

If the display is exposed to intense direct sunlight during a longer period of time the display could become overheated. It is recommended to close the protective display shield. The shield also protects against damages and scratches. "Daylight readable" displays are vulnerable to high temperatures. High temperature will decrease the display service life.

Battery

The battery is rated to operate between 0°C / 32°F and 45°C / 113°F.

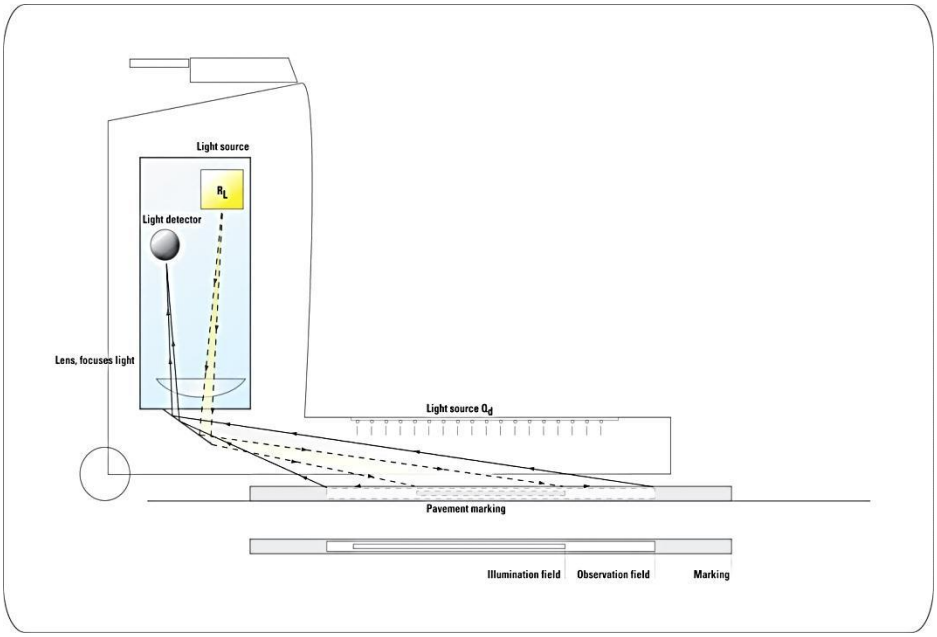


Fig 3. LTL-XL, the inside

SECTION 3

THE USER INTERFACE

Figure 4: The display

Display and keyboard layout

The user interface consists of a rectangular display surrounded by push buttons.
The display has two main modes: the *measurement display* (HOME screen) and the *menu display*. The instrument will start up with the measurement display shown. The display area is divided into four areas: a large main display in the middle, an icon row at the top, a message or caption field underneath and an icon row at the bottom.

Measurement display

Here the last measured R_L and/or Qd values are presented with large digits together with other information. On the graphic above, all possible information is shown in the display. If a function is deactivated, it will not be shown. The actual date and time is always shown.

Upper icon row

The upper row of icons is accessed by pressing the UP button ▲. One of the icons is then highlighted and can be activated by pressing the OK button. The other icons in the row can be accessed by using the LEFT ◄ or RIGHT ►buttons. The meanings of the icons are (from left to right):

- Series ID selection, can be switched off (see **pg.26**).
- User ID selection, can be switched off (see **pg. 19**).
- Error/warning alarm. Will be shown in case of an error/warning (see **pg. 36**).
- GPS indication (see **pg. 24**).
- Battery status (see **pg. 39**).

Lower icon row

- From the lower icon row you can select a road marking icon that will be saved together with the measurement in the log (see **pg. 18**) for future measurement identification. Access the icons by pressing the DOWN button ▼. Use the LEFT or RIGHT button to mark the preferred icon. Pressing DOWN again shows more icon rows from a roll stack of five rows. One row, marked with a *"PR" for "Preset"* can be preset by the user (see **pg. 30**) and is saved separately for each measuring series. It will be the active icon row, ready for selection, when a measuring series is selected.
- Activate the marked icon with the OK button or exit with the HOME or UP ▲ button. The selected icon is now shown in the left side of the HOME screen and the instrument is again ready for measuring.
- Other functionality regarding the lower icon row:
  Activating an already selected icon will cancel the activation and remove the icon from the main display (and no icon will be saved by the next measurement).

Push buttons

OK
When the message row shows MEASURE, press the OK button to take a measurement. In most other cases pressing the OK button will activate a highlighted selection.

ON/OFF
The button turns the instrument *ON* or *OFF*. Press the button to turn the instrument *ON*. It will take 30-40 seconds from cold start, warm start within 1 sec. before the main menu is shown and the instrument is ready to operate.

To turn the instrument *OFF* hold down the button more than 4 second until the display turns black. If the ON/OFF button is held less than 4 seconds the instrument will go into standby mode and enables warm start.

When the instrument is in standby mode, a short press on the button will turn on the display. It is not possible to turn off the instrument during battery charging or when connected to a USB port.

HOME
Bring you back to the measurement display.

BACK
Bring you backward one step in the menu and cancel new settings, which have not yet been confirmed by the OK button. In most cases the LEFT button has the same function.

HELP
The button presents a context sensitive help text. The help presented will be on the subject headline shown in the display. Another press on the button will open up a general help menu.

Menu

The button selects the top level of the menu tree, the main menu. Use the UP and the DOWN buttons to scroll through the menu items. Press OK to select the highlighted item. In most cases it opens up further submenu levels.

SMART

This button is user programmable to one out of several functions, e.g. to clear the last measurement, see **pg. 23**.

CALIBRATE

This button starts the calibration wizard, see **pg. 41**.

PRINT

Print out the last measurement or selected parts of the log to the internal printer.

The menu tree

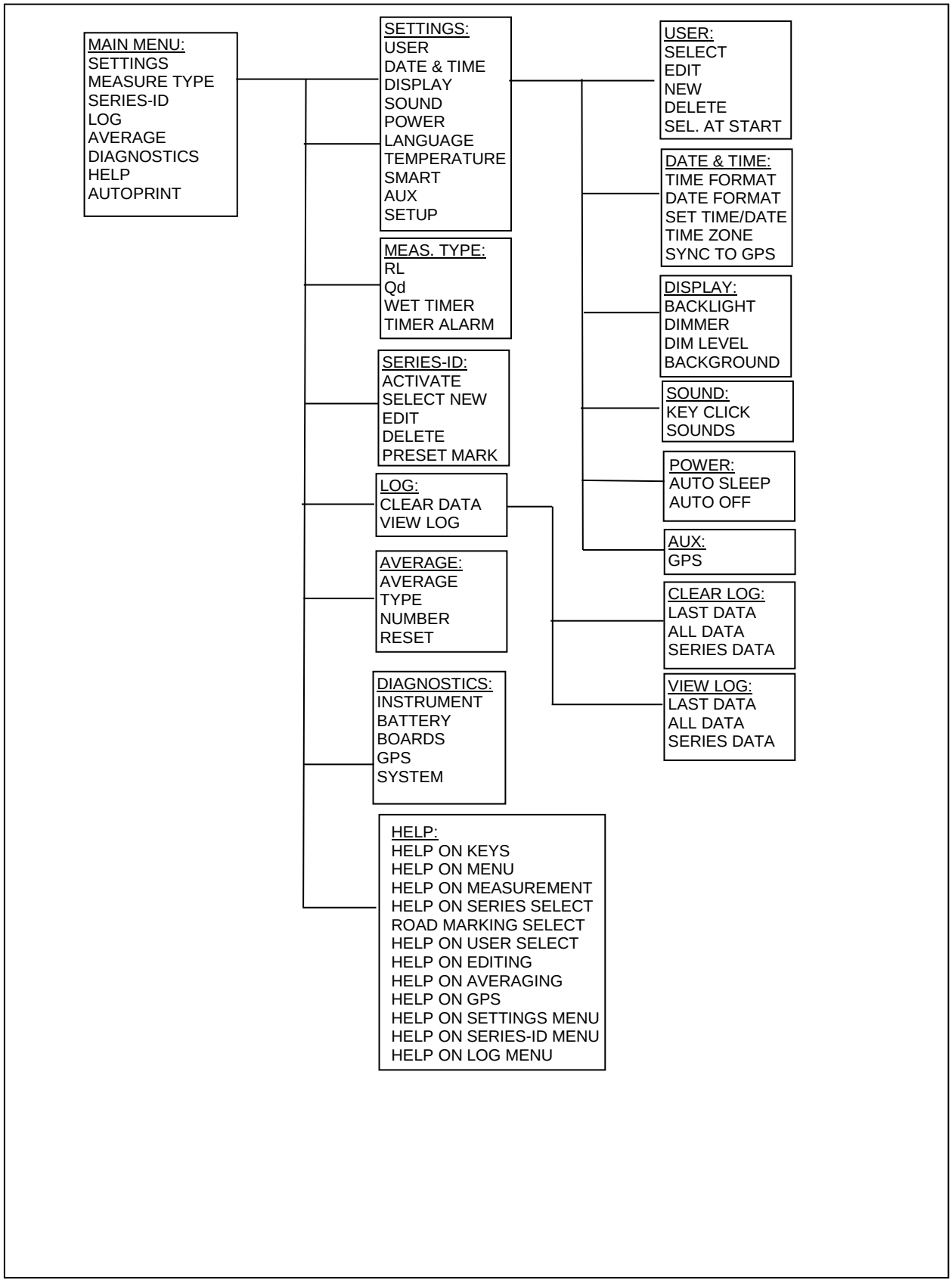


Figure: 5 – The menu tree

SETTING UP FOR MEASUREMENTS

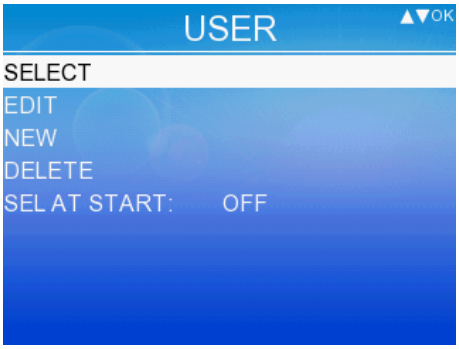
Selecting a User ID

The user ID (user profile) is used to identify the operator and is saved in the log together with each measurement. If enabled, it can be seen at the lower left side of the measurement display. Measurements can also be taken without a user ID. Unlimited user ID's can be stored in the instrument.

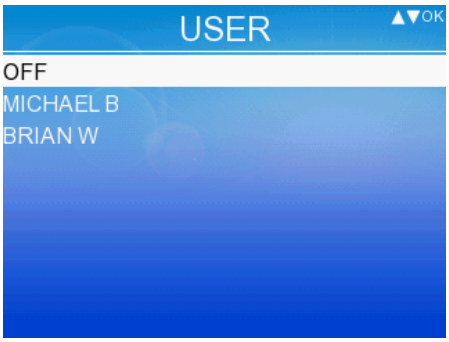
Certain instrument settings are stored individually for each user. Selecting a user will restore these settings. All settings can be stored

The select procedure.

If a user select icon *is not seen in the upper icon row*:
Press the MENU button and select **SETTINGS / USER / SELECT** to display **the USER** menu.



1. *If a user select icon is seen in the upper icon row*:
   Press the UP button. Then, if necessary use the LEFT or RIGHT button to highlight the user icon. Press the OK button. The **USER** menu is shown:



Now use the UP or DOWN button to highlight a user name. Press the OK button to accept the name.

Changes made to the above mentioned individual instrument settings are automatically stored in the selected user ID.

Selecting *OFF* will deactivate the user function and set all individual instrument settings to default.

Edit user

User names can be edited from the menu **SETTINGS / USER / EDIT** (see **editing pg. 35**).

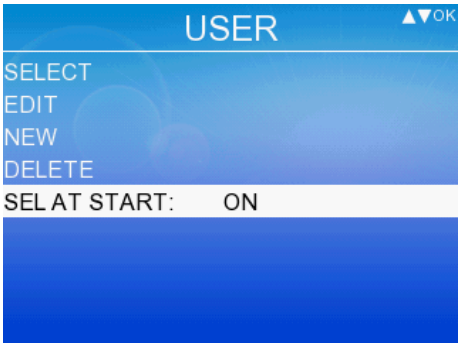
New user

A new user can be entered from the menu **SETTINGS / USER / NEW** (see **editing pg. 35**).

Clear user

Deleting the User ID will remove the user and settings from the memory.

Select at start



Enabling *SEL. AT START* will force the user to select a user ID each time the LTL-XL is turned on.

Press the MENU button and select SEL. AT START. Press OK to toggle between YES and NO

Selecting a road marking icon

The purpose of a road marking icon.
The road marking icons are used as labels for the individual measurement corresponding to the measured road marking and will be saved in the log together with the measuring result. The icon will then be presented together with the corresponding measurement when viewing the log or by using the RSC program (**see pg. 36**).

There are 29 fixed icons to select from. Six of the icons can be programmed as individual pre-sets for each series (**see pg. 30**) and will be ready for selection when a series is selected.

The procedure.
From the HOME screen press the DOWN button. Then use the LEFT or RIGHT button to highlight the wanted icon. Pressing DOWN steps through and displays the five icon rows. Pressing UP will return to the HOME screen without selecting a new icon.

Pressing the OK button will activate the selected icon. The selected icon is now shown in the left side of the measuring field and the instrument is again ready for measuring.

Deactivating the profile icon.
Activating an already selected marking icon will cancel the activation and remove the icon from the main display.

Setting the date and time

Date and time is always shown in the display. Every measurement taken is marked with the date and time, so it is essential that the settings are correct.

Press the MENU button and select **SETTINGS / DATE & TIME**. Press OK and the time format sub menu is shown.

Setting the time format

Press OK when **TIME FORMAT** is highlighted and scroll between 12 and 24 hr format.

Setting the date format

Press OK when **DATE FORMAT** is highlighted.

Highlight the preferred date format using UP or DOWN. Press OK to accept.

Setting the time and date

Press OK when **SET TIME/DATE** is highlighted.

Press OK to activate each line and use UP or DOWN to set the figure. Press OK to accept the setting. Note: the time in this menu is not live, but it will synchronize the time shown in the HOME screen.

Setting the Time zone

Press OK when **TIMEZONE** is highlighted. Press OK to open up the list of countries / national time zones. Scroll to the country / national time zone you live in and press OK to select.

Synchronize to GPS

When **SYNC. TO GPS** is highlighted press OK to scroll between ON and OFF. By activating this function be aware that if the time zone is changed, then recorded date and hour in the memory will be changed to the new time zone. This function will also secure automatic change of day light saving time.

Setting the dimmer and back light (Display)

The backlight and dimmer can be adjusted. Press the MENU button and select **SETTINGS / DISPLAY**.

The levels can be adjusted on a scale from 1 (lowest intensity) to 10. Press OK to activate the function and use UP and DOWN to change the values. Press LEFT or BACK to store.
It is also possible to adjust the time before the light switch to dimmer mode from 5 to 120 seconds or set to OFF. The back-ground colour of the display can be switched off.

WARNING: Using high backlight will drain the battery faster!

Setting the sound level

Press the MENU button and select **SETTINGS / SOUND**. Select **KEY CLICK** or **SOUNDS** to set the individual sound levels for key click and warning and error sounds. Use the UP or DOWN button to set the level at OFF or a scale from 1 to 10. Accept the setting by pressing OK, LEFT or BACK buttons.

Auto Sleep (Power)

To save power the instrument can be setup to automatically change to Auto Sleep mode. The Auto Sleep time can be set from 1 to 30 min. in intervals of 1 min. or it can be deactivated (*OFF*). Startup will be instantaneous pushing the ON / OFF button.

Press the MENU button and select **SETTINGS / POWER / AUTO SLEEP**. Use UP and DOWN to edit the auto turn sleep time. Press OK, LEFT or BACK to accept.

Auto Off (Power)

To save power, the instrument can be programmed to automatically shut off if not used. When communicating with RSC program or when the charger is connected the instrument will not power down automatically. The startup time will be approx. 20-25 seconds.

Press the MENU button and select **SETTINGS / POWER / AUTO OFF**. Use UP and DOWN to edit the auto turn off time. The off time can be set from 1 to 8 hours in intervals of 1 hour or it can be deactivated (*OFF*). Press OK, LEFT or BACK to accept.

Setting the language

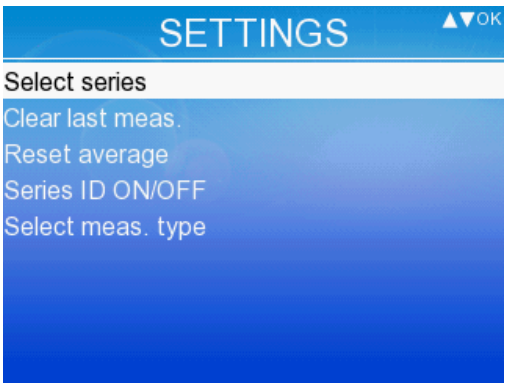
Press the MENU button and select **SETTINGS / LANGUAGE**. Use the UP or DOWN button to select a language. Accept by pressing the OK button or leave unchanged by pressing BACK.

Setting the temperature unit

Press the MENU button and select **SETTINGS / TEMPERATURE**. Use the OK button to select between Celsius and Fahrenheit. Accept by pressing the BACK button.

Setting the SMART key function

This button is user programmable to one of several functions, e.g. to clear the last measurement. Press the MENU button and select **SETTINGS / SMART.**



Use the UP or DOWN button to select the SMART KEY function. Accept by pressing the OK button.

The selected function is now accessed every time is pressed

Setting the AUX functions / GPS (optional)

The AUX function is used to control auxiliary built-in equipment like putting the GPS receiver on and off.

Using GPS (optional)

The GPS receiver is mounted inside the instrument, drawing its power from the internal battery. The GPS system is used to supply position data (latitude and longitude) to the log together with the measurement data.

If activated a GPS icon is shown in the upper icon row (see **picture pg. 15**). The icon will display the quality (reliability) of the GPS signal.

Below is an explanation of the GPS icon states.

GOOD: The GPS HDOP (Horizontal Dilution Of Precision) value is below 5.

FAIR: The GPS HDOP value is larger than 5, but the GPS can FIX.

NO: The GPS cannot FIX (weak or no signal).

The GPS position data, HDOP value, and the number of satellites used in the position calculation are saved in the log together with the R_L and Qd data.

Activating the GPS
Press the MENU button and select **SETTINGS / AUX**, highlight the GPS line and press the OK button to toggle the GPS ON or OFF. Press the BACK button or the HOME button to return to the HOME screen.

The GPS data can be viewed from the HOME screen by pressing the UP button and then highlighting the GPS icon by using LEFT or RIGHT buttons. Press the OK button to display the GPS data. When the GPS data changes the display is updated.

If the GPS does not fix and a measurement is taken a warning menu appears. You will be presented with the following option:

- No GPS fix, Measure anyway, NO / YES

More about the GPS
The GPS unit will typically acquire satellite signals and process a position fix in 1-15 seconds. If the GPS receiver has been turned off for a long period of time (>1 week), the time to first fix will take longer.

The GPS engine used has a navigation performance of 2.5 m CEP[1)]

The precision of the GPS receiver in the LTL-XL is determined by many factors. A few are listed below:

- Signal obstruction. The GPS receiver requires a clear view of the sky. Trees, buildings and other environmental objects may affect the satellite signals.
- Satellite constellation and geometry.
- Multi path (reflection of signal from buildings etc.).

The HDOP (Horizontal Dilution of Precision) is a number that indicates the quality and precision of the received GPS data (low values are better than high).

When the GPS is used, the operating time for the LTL-XL will be decreased and you may have to charge the battery more often.

[1)] CEP (Circular Error Probable):
A statistical measure of the horizontal precision. The CEP value is defined as a circle's radius, when centered at the true position, encloses 50% of the data points in a horizontal scatter plot. Thus, half the data points are within a 2-D CEP circle and half are outside the circle.

Setup

Setup is used to separate between basic and advanced users. The basic settings reduce the number of menus available to the user. For example, in basic menu operation, users cannot clear the log.

The following menu points can be selected in basic mode:

Settings:	User, Date & Time, Display, Sound and Temperature, Setup
Measurement type:	R_L, Qd, Wet timer, Timer alarm
Log:	View log
Diagnosis:	Instrument, Battery, Boards, GPS, System
Help:	All menus available
Auto Print	

ADVANCED setting will provide access to all menu functions.

To change the setup, press MENU and select **SETTINGS / SETUP**. Pressing OK will toggle between *ADVANCED* and *BASIC*. To return from setup press BACK or HOME.

MEASURE TYPE

R_L & Qd

Enables or disables R_L and/or Qd measurement

Wet timer

The wet timer function works for R_L measurements only. The timer can be adjusted between 15 and 60 seconds. The wet timer carries out the measurement after the set period of time.

Timer Alarm

Can be set to carry out automatic measurement or sound an alarm when time to measure.

SERIES ID

Working with series ID

The purpose of a series ID
The series ID is a label, for example the name of a road. Although measurements can be performed without selecting a series ID, it is convenient to group (name) the measurements for each geographical spot, road or part of a road for easier recognition. The series ID for such a group of measurements will be saved in the log together with the measuring results. The ID must be selected prior to the measurement.

The individual measurements in a group can further be labeled by selecting a road marking icon (see **pg. 27**) corresponding to the actual road. Measurements taken with the same series ID are automatically marked.

The instrument can store unlimited series ID's.

Activate

To use the series ID it must be activated. Press the MENU button and select: **SERIES ID / ACTIVATE SERIES**. By pressing OK you can toggle between *ON* and *OFF*, to activate or deactivate the series ID function. Press BACK or press the HOME button to return to the HOME screen. When the series ID is off no ID is shown in the display.

Selecting a series ID

From the HOME screen press UP. If necessary, use the LEFT or RIGHT button to highlight the road icon . Press the OK button. The **SERIES ID** menu is shown. Choose **SELECT** to access the available series ID.

Press the OK button to accept the name.

Enter a new series ID

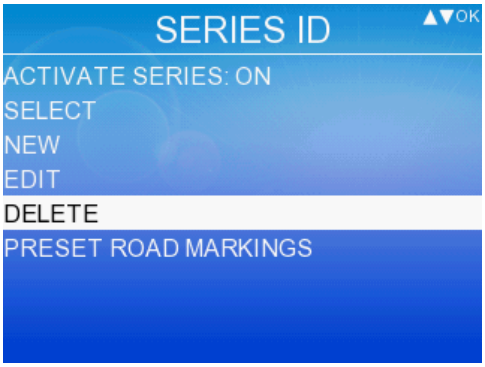
Do the same as above but select **NEW** from **MAIN MENU / SERIES ID**. Proceed by spelling the series name (see **Editing pg. 33**). Press END in the spelling section to save.

Edit a series ID

Do the same as above but select **EDIT** from **MAIN MENU / SERIES ID**. Proceed by editing the series name (see **Editing pg. 33**). Press END in the spelling section to save.

Removing a series ID

This will remove the series ID from the selection list. Press the MENU button and select **SERIES-ID / DELETE**:

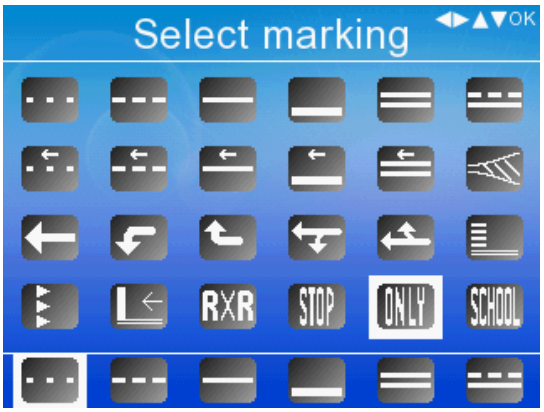


Use UP or DOWN to select the series that should be deleted. Accept by pressing the OK button. A confirmation menu is shown: “Are you sure? Yes. No”
Note! All measurements in the selected series will be erased from the log!

Setting the road marking icon

Six of the 30 icons symbolizing road markings can be programmed as individual presets for each series ID and will be ready for selection when a series ID is selected. Press the MENU button and select **SERIES-ID / PRESET ROAD MARKINGS** to enter the **SELECT MARKING** menu:

The bottom line shows the present six preset icons.



Use the LEFT, RIGHT, UP and DOWN buttons to choose a new icon for the first position, accept by pressing the OK button and the cursor (frame) will move to the second icon. Repeat for all six icons and the programming is done. You can amend at any point by pressing the BACK button and start over again. Press the BACK or HOME button to save.

THE LOG

Each time a measurement is taken data is stored to the log. The following data, among others, are saved, if enabled:

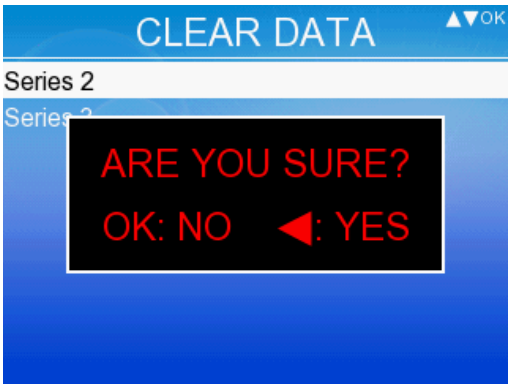
- Measurement result incl. average
- Date and time.
- Name of measuring series (road name) and sequence number.
- Road marking icon
- User name
- GPS data (if installed).
- Instrument status
- Temperature & humidity

The instrument can store >200.000 measurements in the log.

Clearing data in the log

Press the MENU button and select **LOG / CLEAR DATA**:

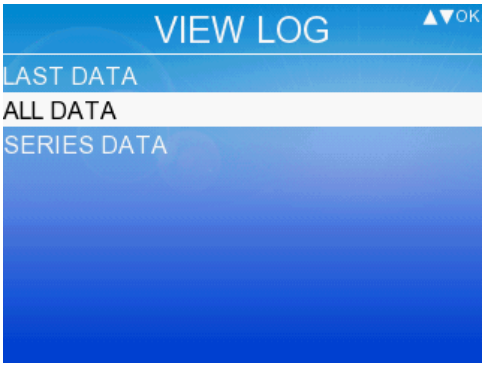
This menu gives the option to clear data; the last measurement, all measurements or one of the measuring series stored in the log. By pressing the OK button you will be asked to confirm the erasure of the data. By pressing LEFT data will be cleared, by pressing OK they will not be cleared.



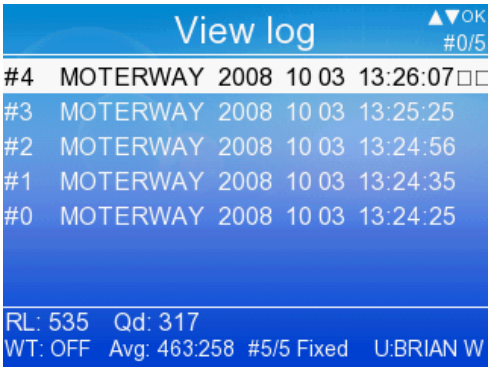
If you selected **SERIES**, you may select the series you wish to delete from the log from the list shown. Only the log entries will be erased. The series will still be available in the series select list.

Viewing the log

Press the MENU button and select **LOG / VIEW LOG**:



This menu gives the possibility to view or print data from either the last measurement, from all measurements or from one of the measure series stored in the log.



The figure below shows the data logged from a measurement

In the first line, the menu shows the R_L and Qd value, thereafter in the following lines other key measurement data. To view a list of the individual errors/warnings in the status, print out the measurement (see below).

Each time a measurement is taken, a status information is generated. If any error occurs the information can be interpreted by the warning/error icon in the top line of the display. The information is available until a new measurement is taken or the problem is resolved. The status information is also stored in the log.

GPS indicates that valid GPS data was stored with the measurement.

Press the PRINT button to print the log from the highlighted measurement.

To return to the log menu, press BACK

View series data.

In the log menu, select **SERIES DATA** to view the list of series.

The menu shows a series ID in each line. By pressing DOWN or UP, the individual series are highlighted. Highlight a series and press the OK button to view the individual measurements.

Highlight a measurement in the individual display and press the PRINT button to print the log.

To return press the BACK button.

OTHER SETTINGS

Average function

An average function can be activated showing the average of the measured R_L & Qd values calculated over a selectable number of measurements (N = 2 to 25). The average mode can be **fixed** or **moving**. In **moving** mode the average is always calculated from the last N measurements where N is the selected number of measurements. In **fixed** mode the averaging will start over again when N measurements have been taken. The average data is shown in the HOME screen at the lower right corner (see **picture pg. 15**).

Press the MENU button and select AVERAGE:

AVERAGE:

Use the UP or DOWN button to highlight the first line. Press the OK button to toggle between AVERAGE *ON* and AVERAGE *OFF*.

TYPE:

Highlight the second line and press the OK button to toggle between type: MOVING and type: FIXED.

NUMBER:

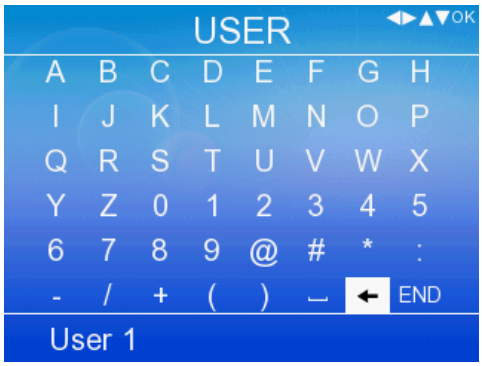
Highlight the third line and press the OK button to focus on the NUMBER digits. Then use the UP or DOWN button to change the value between 2 and 25. Finally press the OK button to confirm the new value. The default setting is 4.

RESET:

Highlight the fourth line and press the OK button to reset the calculated average value and reset the number of measurements included in the average to zero.

Editing names

From certain points you arrive to the EDIT menu e.g. is you want to define a USER. You will arrive to the following screen:



With UP, DOWN, LEFT and RIGHT you can navigate around the letters, numbers, symbols and space. The "arrow" will take you one step back. Press enter to select. When you have finished, press END to return to the menu, where you started.

Auto print

Press the MENU button and highlight **AUTOPRINT.** Press the OK button to toggle between ON and OFF. If **AUTOPRINT** is activated a print is automatically made every time a measurement is taken. Press BACK to return to MENU.

Diagnostics

Press the MENU button. Highlight the line **DIAGNOSTICS**. Press the OK button, and the menu showing the following:

Each line gives information aimed at extended service and factory use. The information presented on the screen will be printed if you press the PRINT button.

The help system

Press the HELP button to show a context dependent help page. Pressing HELP once more will present a general help menu in which you can highlight a subject by using the UP or DOWN button and the press the OK button to show the help text. The HELP section is also accessible on the main menu.

Errors and warnings

When a measurement is taken, a warning text is generated if a problem arises and saved in the log together with the measurement. If a problem occurs, a warning icon or an error icon is show above the HOME screen and an audible alarm is sounded (if enabled) and error is stored in the log.

To view the nature of the problem, press the UP button and the warning/error icon will be highlighted. The most severe problem will be stated in the message line underneath.
Then press the OK button to view a total list of problems starting with the most severe.
Press the BACK button to return to the HOME screen. If the problem did not hinder the completion of the measurement, the erroneous value(s) will be saved in the log, which can identify the problems when the log is evaluated using the RSC program. If an error is registered the measurement will not be recorded.

RSC software program

Main features of the RSC (Road Sensor Control) software program delivered together with the LTL-XL:

- Transfer of log data to a PC
- Export of log data to other programs e.g. spread sheets
- Printing reports of the log data

For more details see the separate user's manual for the RSC program, found on the installation CD.

SECTION 4

MAINTENANCE

General care

The retroreflectometer is constructed for outdoor use in ordinary good weather conditions. It will stand moist weather with wet roads, but caution must be taken against heavy rain and dirt. The LTL-XL retroreflectometer is an optical instrument and shall be handled as such. Avoid shock and vibration if possible.

Protection window

The protection window is accessible from underneath of the instrument. The protection window is coated with a high-efficiency anti-reflection coating. Take care not to damage this coating when cleaning. Compressed air or a fine brush can be used for removing loose particles/dust. If this is not sufficient the window should by cleaned using a soft paper tissue or cloth and some window cleaning liquid.

MAKE SURE THE PROTECTION WINDOW IS CLEAN AND UNDAMAGED AT ANY TIME TO ENSURE CORRECT MEASUREMENT RESULTS

Battery

The LTL-XL retroreflectometer is powered by a 12V/2.1 Ah NiMH (Nickel-Metal Hydride) battery. Under normal use, this battery requires no maintenance. However it is recommended to keep the battery fully charged. A fully charged battery is more capable of withstanding degeneration.

A battery charger power supply is provided as a standard accessory for charging the battery from mains. The output cable of the charger is equipped with a connector matching the connector in the instrument. Connect the charger to an outlet and the instrument. If the instrument was turned off it will automatically power on when the charger is being connected. The battery icon in the upper right corner will also indicate the charging state.

No harm will result from leaving the charger connected after the charging process. However, the instrument must be disconnected from the charger when disconnecting the battery from the wall outlet. In addition, the battery can be charged using any DC supply from 12-18 V. such as a car battery by using an inverter or the 12V charger supplied by DELTA (optional).

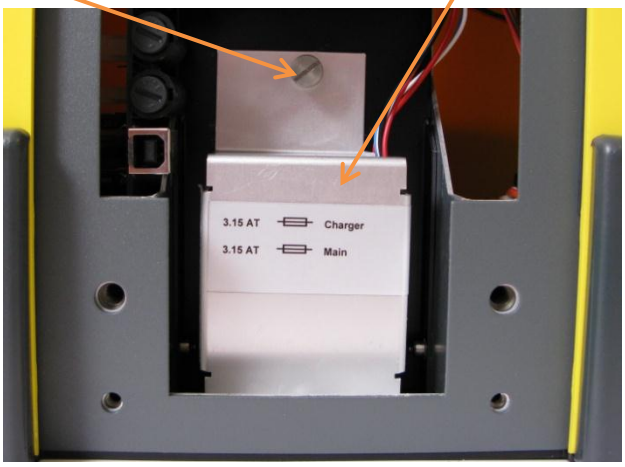
When storing the instrument for a long period of time fully charge the battery.

THE BATTERY SUPPLIED WITH LTL-XL IS SPECIALLY DESIGNED FOR THE INSTRUMENT TO ENSURE SAFE USE. IF A NON DELTA SUPPLIED OR APPROVED BATTERY IS USED WITH LTL-XL DELTA CAN TAKE NO RESPONSIBILITY FOR ANY DAMAGED CAUSED DUE TO THE PERFORMANCE OF THIS BATTERY.

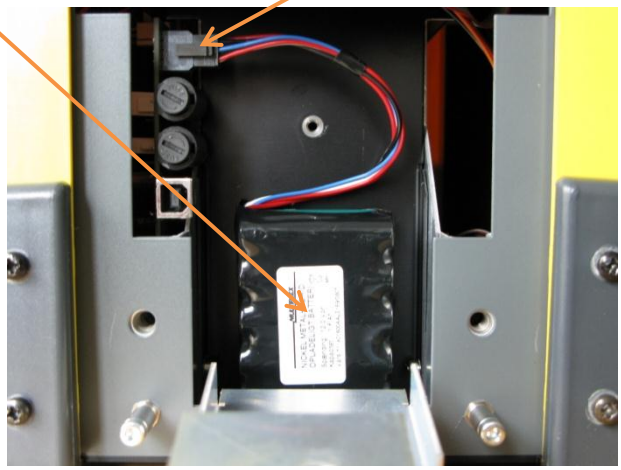
Replacing the battery
A worn out battery will not hold a charge very long. When the battery is worn out it must be replaced. The user can do this.

The battery is located in a compartment at the low end of the rear of the tower. To replace the battery, remove the screws from the back cover and remove the cover.

Loosen the big screw at the battery cover. You can now remove the cover



Lift the battery out of the compartment. Press the snap-on clip on the connector and carefully withdraw it from the printed circuit board



The battery can now be removed and replaced. Refit in reverse order. Please check your local regulation for disposal of the battery

Battery status
The capacity of the battery can be seen from the icon in the upper icon row.

Indicates that the battery is fully charged

Shows that the fast charging is finished

Shows that fast charging takes place

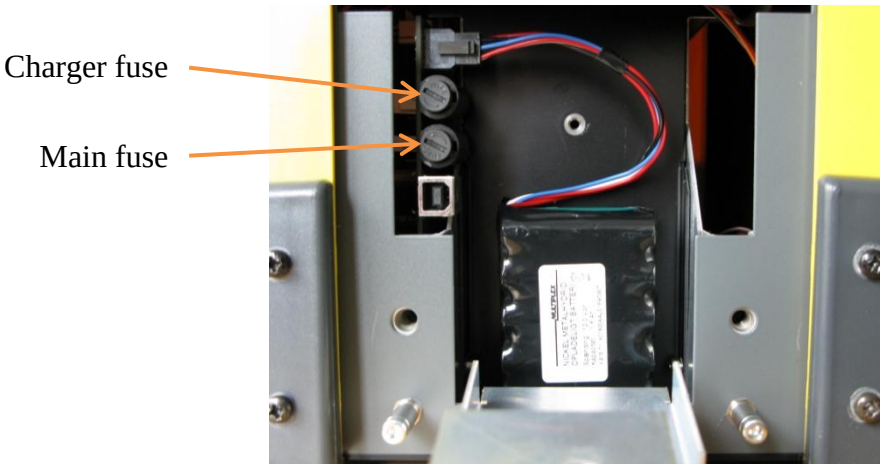
Indicates that the capacity of the battery is half empty

The battery is almost empty and need recharging

Fuses

Two fuses are located in the battery compartment. The charging fuse protects the battery against short circuit and other errors in the charging connector, charger or charging system.
The battery fuse protects the battery and electronics against short circuit and other errors in the electronic system.

Always replace a blown fuse with one of equal rating **See Electrical Characteristics pg. 44.** To change the fuses you need access to the battery compartment. **See replacing battery pg. 35.** Carefully unscrew the plastic cap fuse holder by using e.g. a coin. Pull out the fuse from the cap and insert the new one and reassemble



Lamp

The lamps are maintenance free LED lamps. Only trained personnel should replace the lamps if damaged.

Calibration unit

Reference
The road marking is simulated by a piece of white ceramic (the reference) mounted on an aluminum profile. Ceramics have very stable optical properties because of the smooth surface.

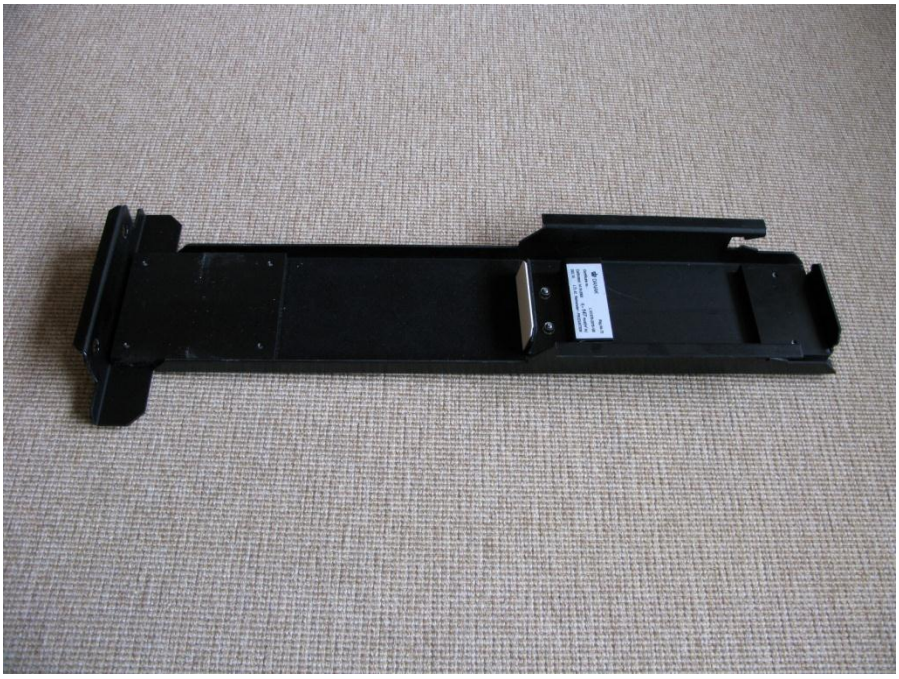


Figure: 6 - Calibration normal

To make sure that calibration of the retroreflectometer is correct it is important that the ceramics and light trap on the calibration unit is clean and undamaged. Always keep the calibration unit well protected.

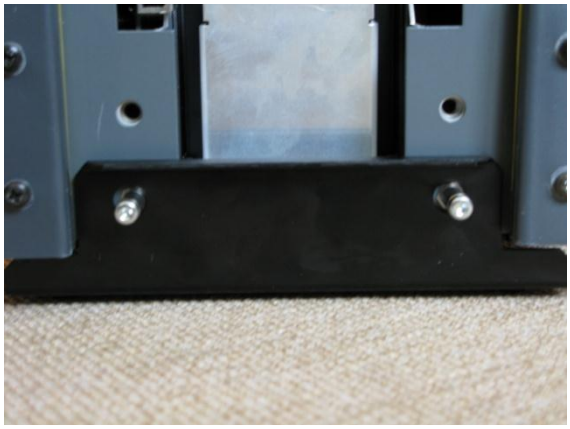
If the ceramic is stained, scratched or broken, the calibration unit has to be repaired and recalibrated. In case of dust on the ceramics surface of the reference, the use of compressed air is recommended for removal. The use of a soft damp cloth is recommended if compressed air fails to remove the dirt. If necessary, use a mild household detergent.

Service
To ensure reliable measurements, it is recommended that the calibration unit be periodically recalibrated to a traceable standard. DELTA offers calibration traceable to PTB (Physikalsich-Technische Bundesanstalt, Germany) and NIST (National Institute of Standards and Technology, USA).

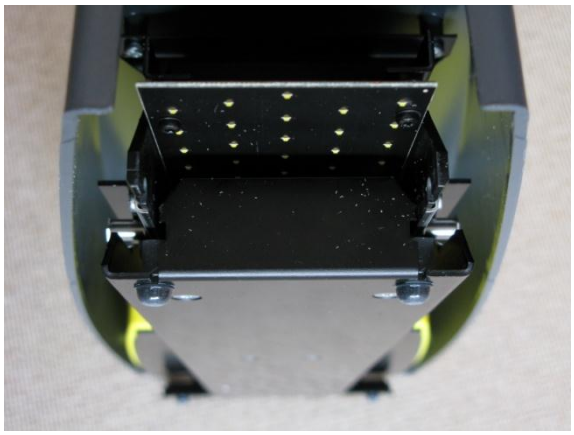
For information in service please contact your distributor or DELTA directly. At DELTA you can forward your request via our web-site www.roadsensors.com or send a mail directly to: roadsensors@delta.dk.

Calibration

The LTL-XL is factory calibrated and very stable but a calibration should always be carried out before starting a new series of measurements. The instrument is supplied with a calibration unit to carry out a fast and easy calibration.



Back



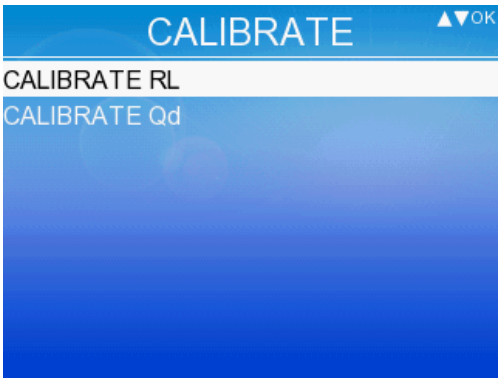
Front

Figure 7: Placing the calibration unit

Calibration procedure

- Before mounting the calibration unit check the R_L and Qd values stamped on the calibration unit. Place the instrument upon the calibration unit and pull back until the pins at the back and front of the LTL-XL are in place, see figure 7. Please be very careful when you place the instrument on the calibration plate not to damage the calibration unit and / or the light diodes

Press the CALIBRATION button once. Select **CALIBRATE R_L** or **CALIBRATE QD.**



Continue the calibration process applying the following steps

- Check the value displayed and, if necessary, adjust the calibration value shown in the display so it matches the value stamped on the calibration unit.

- Press the OK button to finish the calibration or repeat if erroneous.
- Repeat the calibration process for the other measure (R_L, Qd)

The calibration procedure is now complete. To check the calibration, make a normal measurement on the calibration unit. The recorded values should be with +/- 2-3 units of the values stamped on the calibration unit. Remove the calibration unit and store it properly. Press OK to return to the measurement display. For further details see **pg. 41**.

The instrument automatically compensates for zero signals, leakage and other known errors, and calculates a calibration factor.

Always store the calibration unit in a dry, dust free and clean environment.

Printer (optional)

The printer is located at the back of the tower. The printer is a high-speed high quality mini thermal printer. It has only a few moving parts and does not require any special or periodic maintenance.

The printer uses a thermal paper roll, width: 57.5±0.5 mm (2.26 in), diameter: max. 31 mm (1.22 in)

Replacing paper

Replacing the paper is simple. First, pull the little lever out with your finger and the cover will open into the paper roll compartment.

Insert the new paper roll and let a short paper tail hanging out at the top. Close the cover with a firm push and with some of the paper sticking out.

Mounting the wheel unit (option)

A wheel unit can be mounted in the rear of the instrument for easy transportation during heavy use.

The wheels are mounted easily to the rear by fastening the two nuts mounted on the wheel block.

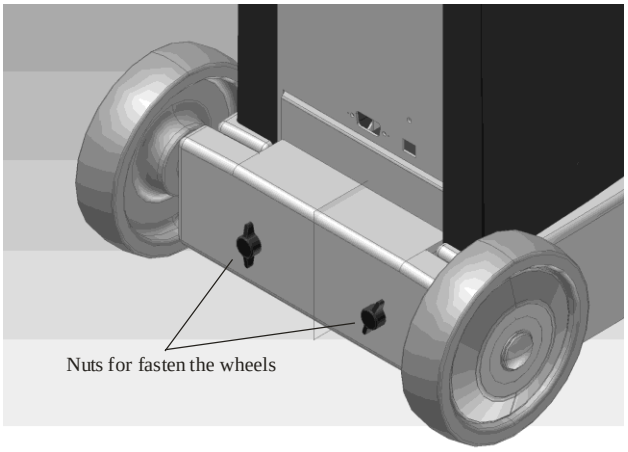


Figure: 8 – Mounting the wheels

APPENDIX A

COMMUNICATION FACILITIES

The LTL-XL is equipped with a USB Master Port and a USB Device Port.

The USB Master Port can be used to connect to a USB memory stick, e.g. for software updates.

The USB Device Port is used to connect the instrument to a PC.

The ethernet connector is for test / service purpose.

APPENDIX B

SPECIFICATION

General characteristics

Illumination angle 1.24º
Observation angle 2.29º
Equivalent observer distance ..... 30 m

Observation angular spread ..... ±0.17º
Type 30m CEN
Illumination angular spread horizontal 0.33º
Illumination angular spread vertical 0.17º

Field of measurement:
Width ..... 50 mm (2.0 in)
Length (typ.) ..... 185 mm (7.3 in)

R_L range ($mcd \cdot m^{-2} \cdot lx^{-1}$) 0-2000
Qd range ($mcd \cdot m^{-2} \cdot lx^{-1}$) 0-318

Radio: ..... EN 300440-1 V1.6.1:2010
EMC: ..... EN 301489-1 V1.8.1:2008, EN 301489-3 V1.4.1:2002
Safety : ..... EN/IEC 60950-1 :2006, EN/IEC 60950-22 :2006
FCC: ..... 47 CFR, FCC Part 15B, Class A

Power supply:
Battery ..... Built in 12 volt / 2.1 Ah NiMH
External charger power supply ..... Friwo FW7530/15 (100-240 VAC / 15VDC)
Charging time ..... Approx. 1 hour 30 min

Charger fuse (5*20 mm) T3.15A
Power supply fuse (5*20 mm) T3.15A

Data memory ..... >200.000 measurements

Data transfer ..... USB 2.0

Environmental characteristics

Temperature:

Operating..... 0ºC to + 45ºC (32ºF to +113º F)

Storage[*)] .....-15ºC to + 55ºC (5º F to +131º F)

Humidity..... 85% and non-condensing

[*)] Battery must be fully charged

Mechanical characteristics

Max. length.....573 mm / 22.56 in

Max. width.....222 mm / 8.74 in

Max. height.....538 mm / 21.18 in

Weight of base unit.....7 kg / 15.5 lbs

Construction:

Structural parts .....Aluminum

Housing .....Polymer

Keyboard.....Silicone rubber

Circuit boards.....Epoxy glass

Printer:

Thermal paper .....width/dia. 57.5 ±0.5 mm / 31mm (2.26 in / 1.22in)

APPENDIX C

DELIVERY